SECTION 994
RETROREFLECTIVE AND NONREFLECTIVE SHEETING AND SIGN PANEL FABRICATION

994-1 Description.

994-1.1 General: This Section specifies the requirements for retroreflective and nonreflective sheeting and sign panel materials and fabrication. This includes the sign sheeting materials such as transparent and opaque process inks for retroreflective sheeting materials, vinyl and transparent overlays.

994-2 Retroreflective and Nonreflective Sheeting Systems.

994-2.1 Materials: Retroreflective sheeting material will be classified in accordance with and meet the requirements of ASTM D4956. Overlay materials include colored and colorless transparent overlays and vinyl.

994-2.2 Approved Product List (APL): All sheeting, process inks and overlay materials will be listed as a system on the Department's Approved Product List (APL). Sign sheeting systems will consist of base sheeting with ink and/or overlay materials. Products with an ASTM classification of Type XI or greater will not be accepted for qualification on the APL for fluorescent orange, fluorescent yellow and fluorescent yellow-green. Manufacturers seeking evaluation of their products need to submit product data sheets, performance test reports from an independent laboratory showing the sign sheeting system meets the requirements of this Section, and a APL application in accordance with Section 6. Information on the APL application must include the individual materials comprising the sign sheeting system and identify colors, ASTM base sheeting classification, adhesive backing class, availability of transparent and/or opaque backing and availability of liner types. Submit an infrared identification curve (2.5 to 15 μm) for each color of ink.

994-2.3 Performance Requirements.

994-2.3.1 General: Sheeting, process inks and overlay materials must be tested in accordance with, and meet all the performance requirements of ASTM D4956, including Supplemental Requirement S2, Reboundable Sheeting Requirements, except as amended in this Section.

For performance requirements that are color dependant, each color included in the APL application must be tested and meet the requirements identified in ASTM D4956 or this Section as applicable. Purple sign sheeting materials must meet the color requirements as identified in the 23 CFR 665 Table 1 to Appendix to Part 655, Subpart F. All sign sheeting systems consisting of inks and/or overlays will be tested as a system consisting of white base sheeting and each color of ink and/or overlay.

Panels for testing sheeting must be prepared in accordance with 994-3 for testing. The in-service life for the sign sheeting system will equal the life of the reflective base sheeting of the system.

994-2.3.2 Retroreflective Intensity: The retroreflectivity of sheeting and sheeting systems must meet the minimum initial requirements as stated for all observation and entrance angles as indentified in ASTM D 4956. The 0.2 and 0.5 degree observation angles with an entrance angle of minus 4 degrees per ASTM D4956 will be used for in-service requirements.

Rotational sensitivity shall be tested in accordance with AASHTO M268. Rotationally sensitive sheeting will be noted on the APL.

Type VI Sheeting	
Minimum Coefficient of Retroreflection (cd/foot-candle·ft^2)(cd/fc·ft^2)	
Observation/Entrance Angle	Fluorescent Pink
(degree)	
0.2/-4	160
0.5/-4	100
0.2/30	100
0.5/30	40

994-2.3.3 Clear Overlay Films: Clear overlay film must be compatible with the sign sheeting system and not delaminate or discolor for the in-service life of the system. Submit spectrophotometer analysis indicating the luminous transmittance across the wavelength range from 325 nm to 700 nm in accordance with ASTM D1003 Procedure B. Film shall filter less than 1.0% luminous transmittance for 325 nm to 350 nm.

994-2.3.4 Color: The fluorescent pink initial color shall meet the following x, y chromaticity coordinates:

Fluorescent Pink	1	2	3	4
x	.450	.590	.644	.536
y	.270	.350	.290	.230

Fluorescent pink sheeting shall have a minimum luminance factor of 25.

994-2.3.5 Outdoor Weathering: Outdoor weathering exposure of sign sheeting systems will be in accordance with, and meet the requirements of ASTM D4956 for each system, color and classification. All testing will be conducted at an exposure location meeting the Tropical Summer Rain Climate Type (Miami, Florida or equivalent). Outdoor weathering is not required for Type VI fluorescent pink.

994-2.3.6 Packaging and Labeling.

Packaging and labeling must meet the requirements of ASTM D4956.

994-2.3.7 Samples.

Field samples will be obtained in accordance with the Department's Sampling, Testing and Reporting Guide Schedule and on a random basis at the discretion of the Engineer.

994-3 Sign Panels.

994.3.1 Materials: For aluminum sheets and plates for sign panels, meet the requirements of ASTM B 209, Aluminum Association Alloy 6061-T6, 5154-H38 or 5052-H38 and those shown in the Plans.

994-3.2 Preparation of Sign Blanks.

994-3.2.1 De-greasing and Etching for Aluminum Sign Blanks:

994-3.2.1.1 General: Prior to the application of retroreflective sheeting, use any of the methods shown below to de-grease and etch the aluminum sign blanks.

994-3.2.1.2 Hand Method: Under this method, de-grease and etch the blanks in one operation, using steel wool (medium grade) with any of the following combinations of materials:

1. An abrasive cleanser of a commercial grade kitchen scouring powder.
2. Acid and a suitable detergent solution.
3. An alkaline solution.

Thoroughly rinse the blanks with clean water following all hand de-greasing operations.

994-3.2.1.3 Power-Washer Method: Under this method, de-grease the blanks with an inhibited alkaline cleanser, by spraying for 90 seconds with the solution between 135 and 249ºF, the exact temperature to be as recommended by the manufacturer of the cleanser. After the spraying, rinse the blanks with clean water. Then etch the blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100 to 180ºF for 60 seconds. After immersion, rinse the blanks in clean water.

994-3.2.1.4 Immersion Method: Under this method, de-grease the blanks by immersing them in a solution of inhibited alkaline cleanser at a temperature between 160 and 180ºF for three to five minutes, and then rinsing with clean water. Then etch blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100ºF for three minutes. After immersion, rinse the blanks in clean water.

994-3.2.1.5 Vapor De-greasing Method: Under this method, de-grease the blanks by totally immersing them in a saturated vapor of trichloroethylene. Remove trademark printing with lacquer thinner or a controlled alkaline cleaning system.

994-3.2.1.6 Alkaline De-greasing Method: De-grease the blanks by totally immersing them in a tank containing an alkaline solution, controlled and titrated in accordance with the solution manufacturer's directions. Adapt immersion time to the amount of soil present and the thickness of the metal. After immersion, thoroughly rinse the blanks with running water.

994-3.2.1.7 Etching Method when De-greasing is Separate Operation: If using either of the de-greasing methods described in this section, accomplish etching by one of the following alternate methods:

1. Acid Etch: Etch well in a 6 to 8% phosphoric acid solution at 100ºF, or in a proprietary acid etching solution. Rinse thoroughly with running cold water, which may be followed by a hot water rinse.
2. Alkaline Etch: Etch aluminum surfaces in an alkaline etching material that is controlled by titration. Meet the time, temperature, and concentration requirements specified by the solution manufacturer. After completing etching is complete, rinse the panel thoroughly.

994-3.2.1.8 Chromate Coating: Before applying retroreflective sheeting to the aluminum, treat the aluminum sign surfaces with chromate conversion coating. Coating may consist of an organic or inorganic chromate material. Coatings shall be applied according to the manufacturer's instructions and shall conform to ASTM B449, Class 2.

994-3.3 Drying: Dry the panels using a forced-air drier. Use a device or clean canvas gloves, to handle the material between all cleaning and etching operations and the application of

retroreflective sheeting. Do not allow the metal to come in contact with greases, oils or other contaminants prior to the application of retroreflective sheeting.

994-3.4 Fabrication of Sign Blanks: Fabricate all metal parts to ensure a proper fit of all sign components. Complete all fabrication, with the exception of cutting and punching of holes, prior to metal de-greasing and applying the retroreflective sheeting. Cut metal panels to size and shape and keep free of buckles, warp, dents, burrs, and defects resulting from fabrication. Use aluminum sheets with increments of 4 feet in width; except, for sign widths that are not multiples of 4 feet. A maximum of two panels may be cut to less than 4 feet, and no panel may be cut to less than one foot. Mount aluminum sheets vertically and provide backing strips at vertical joints to keep the abutting sheets in proper alignment.

Ship all multi-panel signs to the project intact, completely assembled and ready to be installed. Fabricate signs taller than 10 feet as two separate signs with a horizontal splice, ready to be spliced and installed.

994-3.5 Fabrication of Retroreflective Sign Faces.

994-3.5.1 General: Fabricate signs with sign sheeting systems listed on the APL meeting the requirements in Section 700, Design Standards and Plans.

994-3.5.2 Application of Sheeting: Apply retroreflective sheeting to the base panels with mechanical equipment in a manner specified for the manufacture of traffic control signs by the sheeting manufacturer. For sheeting that has been identified as rotationally sensitive, apply white sheeting for cut-out legends, symbols, borders and route marker attachments within the parent sign face at the optimum rotation angle according to the identification markings. Apply all background sheeting at a uniform rotational angle. The retroreflective sheeting for each sign will be from the same roll or lot number. Apply consecutively alternate successive width sections of either sheeting or panels to ensure that corresponding edges of sheeting lie adjacent on the finished sign. If the sign cannot be constructed from retroreflective sheeting from the same roll or lot number, the fabricator may color match from a different lot; the color between the rolls cannot exceed three ΔE's using test method ASTM D 2244. The Engineer will not accept nonconformance that may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting or non optimum retroreflectivity in the finished sign and installation.

Sheeting is to be trimmed at 45 degree angle from the edge of each panel. Finish signs by sealing sheeting splices and sign edges according to sign manufacturer recommendations.

994-3.5.3 Direct and Reverse Screen Processing: Screen message and borders on retroreflective sheeting in accordance with the recommendations of the ink or overlay manufacturer. Process messages either before or after applying the sheeting to the base panels.

The transparent and opaque process inks furnished for direct and reverse screen processing shall be of a type and quality formulated for retroreflective sheeting materials as listed on the APL and applied in accordance with the manufacturer's instruction. Screen processing in accordance with the techniques and procedures recommended by the manufacturer must produce a uniform legend of continuous stroke width of either transparent or opaque ink, with sharply defined edges and without blemishes on the sign background that will affect the intended sign use.

994-3.5.4 Finished Sign Face: Provide finished signs with properly aligned clean cut and sharp messages and borders. Fabricated signs must be free of wrinkles, bubbles, foreign

matter, scratches, free of patches, or other visually identifiable defects. Ensure that finished background panels are essentially a plane surface.

994-3.5.5 Packaging and Labeling: For permanent roadway signs, label the back of all finished panels at the bottom edge with "FDOT", the date of fabrication, sign sheeting system manufacturer, Type, and the fabricator's initials. Make the labels unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the label in a manner that is at least as durable as the sign face.

Properly package signs to protect them during storage, shipment and handling to prevent damage to the sign face and panel.